**CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| States of Matter (GE-7) | 4 | 2 | | 2 | | |

## Learning Objectives

The Learning Objectives of this course are as follows:

- To make students learn about the properties of ideal and real gases deviation from ideal behaviour, properties of liquid, types of solids with details about crystal structure.
- To make student learn about the reaction rate, order, activation energy and theories of reaction rates.

## Learning Outcomes

**By the end of the course, the students will be able to:**

- Derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal
- behaviour.
- Explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases.
- Explain the properties of liquids especially surface tension and viscosity.
- Explain symmetry elements, crystal structure specially NaCl, KCl and CsCl
- Define rate of reactions and the factors that affect the rates of reaction.
- Understand the concept of rate laws e.g., order, molecularity, half-life and their determination
- Learn about various theories of reaction rates and how these account for experimental observations.

## SYLLABUS OF GE-7

**Theory:**

**Unit 1: Kinetic Theory of Gases**                                   **(12 Hours)**

Postulates of kinetic theory of gases and derivation of the kinetic gas equation, deviation of real gases from ideal behaviour, compressibility factor, causes of deviation, van der Waals

equation of state for real gases. Boyle temperature (derivation not required), critical phenomena, critical constants and their calculation from van der Waals equation, Andrews isotherms of $CO_2$, Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions, most probable, average and root mean square velocities (no derivation), collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules, viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

## Unit 2: Liquids State                                          (6 Hours)

Surface tension and its determination using stalagmometer, Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer, effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents.

## Unit 3: Solid State                                             (12 Hours)

Forms of solids, symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of crystallography - law of constancy of interfacial angles. Law of rational indices, Miller indices. X–ray diffraction by crystals, Bragg's law and powder XRD. Powder diffraction patterns of NaCl, CsCl and KCl (qualitative treatment only), defects in crystals. Glasses and liquid crystals.

## Practicals:                                                     (60 Hours)

### (Laboratory periods: 60)

1. Surface tension measurement (use of organic solvents excluded): Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
2. Viscosity measurement (use of organic solvents excluded):
a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald viscometer.
b) Study of the variation of viscosity of an aqueous solution with concentration of solute.
3. Solid State: Powder XRD
c) Differentiate and classify the given set of the diffraction pattern as crystalline materials or amorphous (Glass) substance.
d) Carry out analysis of a given set of powder XRD and determine the type of the cubic crystal structure
e) Determination of approximate crystal size from a given set of powder XRD

## References:

**Theory:**
1. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkin's Inorganic Chemistry**, Oxford.
2. Miessler, G. L.; Tarr, D.A. (2014), **Inorganic Chemistry**, Pearson.
3. Castellan, G. W. (2004), **Physical Chemistry**, Narosa.

4.  Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol.1, 6th Edition, McGraw Hill Education.
5.  Kapoor, K.L. (2015), **A Textbook of Physical Chemistry**, Vol.5, 3rd Edition, McGraw Hill Education.

**Practicals:**

1.  Khosla, B.D.; Garg, V.C.;Gulati, A.(2015),**Senior Practical Physical Chemistry**, R. Chand & Co.

## GE 9: Chemistry: Conductance and Electrochemistry

**CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

| Course title & Code | Credits | Credit distribution of the course | | | Eligibility criteria | Pre-requisite of the course |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| Conductance and Electrochemistry (GE-9) | 4 | 2 | | 2 | | Basic knowledge of Chemistry |

### Learning Objectives

The Learning Objectives of this course are as follows:
- To make students learn about conductance, its measurement and applications.
- To make students learn the principles of electrochemical cells: Electrolytic and Galvanic cell, measurement of, measurement of emf and its applications.

### Learning outcomes

**By the end of the course, the students will be able to:**

- Explain the factors that affect conductance, migration of ions and application of conductance measurement.
- Understand different types of galvanic cells, their Nernst equations, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements.
- Understand applications of Emf measurements in relation to determination of activity coefficients, pH of a solution and Potentiometric titrations.

### SYLLABUS OF GE-9

**Theory:**

**Unit 1: Conductance**                                                        **(10 Hours)**